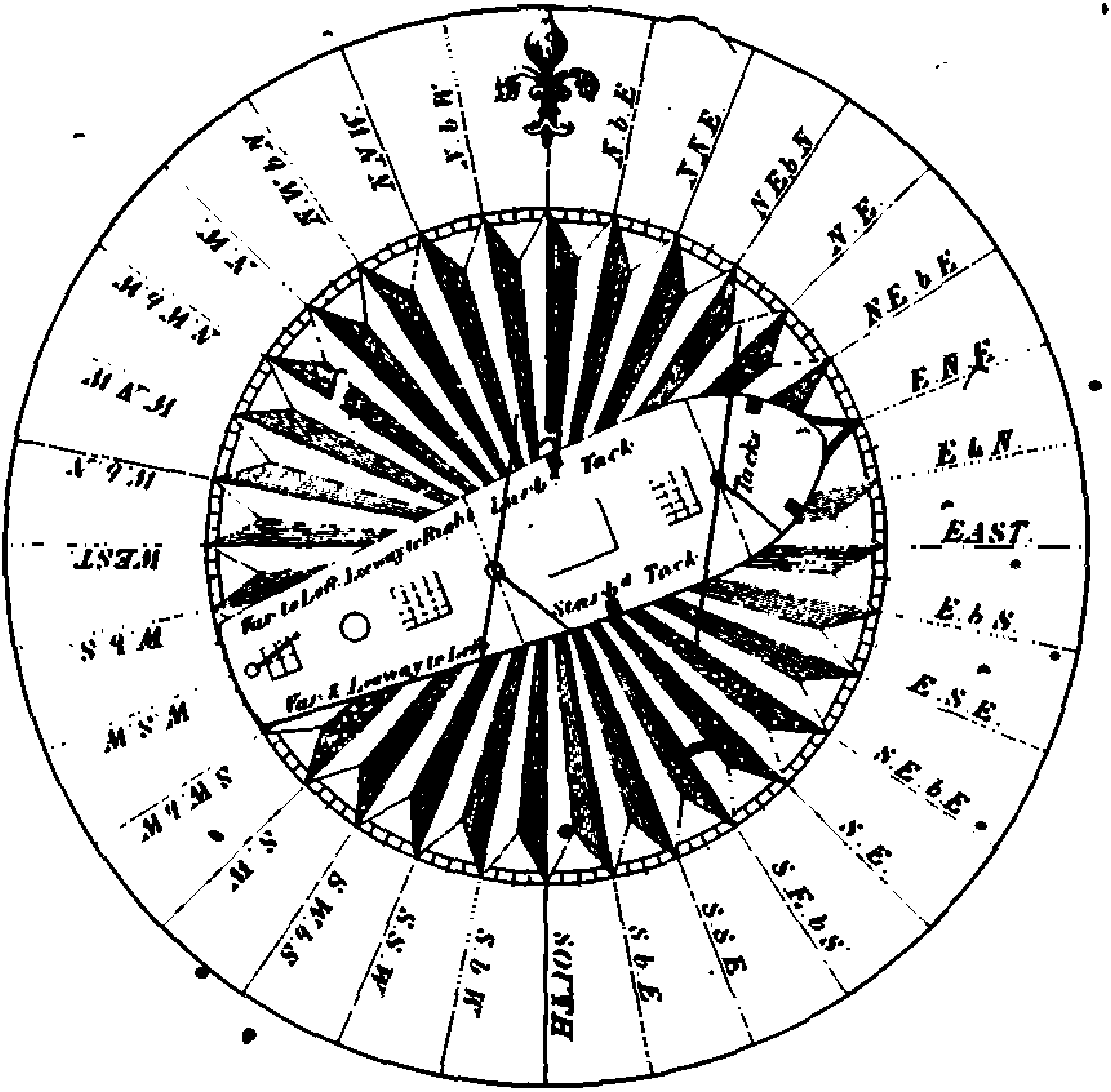
THE COURSE CORRECTER

AND

PRACTICAL SEAMANSHIP.

BY EDWARD LOGGAN.

Original Inventor



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THE
LATITUDE AND COURSE
CORRECTOR,

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WITH MANY

USEFUL IMPROVEMENTS IN NAVIGATION.

BY EDWARD LOGGAN,

HAVING HAD FOR MANY YEARS, AS MASTER MARINER, CONSIDERABLE PRACTICE IN MOST PARTS OF THE WORLD; TEACHER OF NAVIGATION AND NAUTICAL ASTRONOMY TO PASS GOVERNMENT EXAMINATION.

LONDON:
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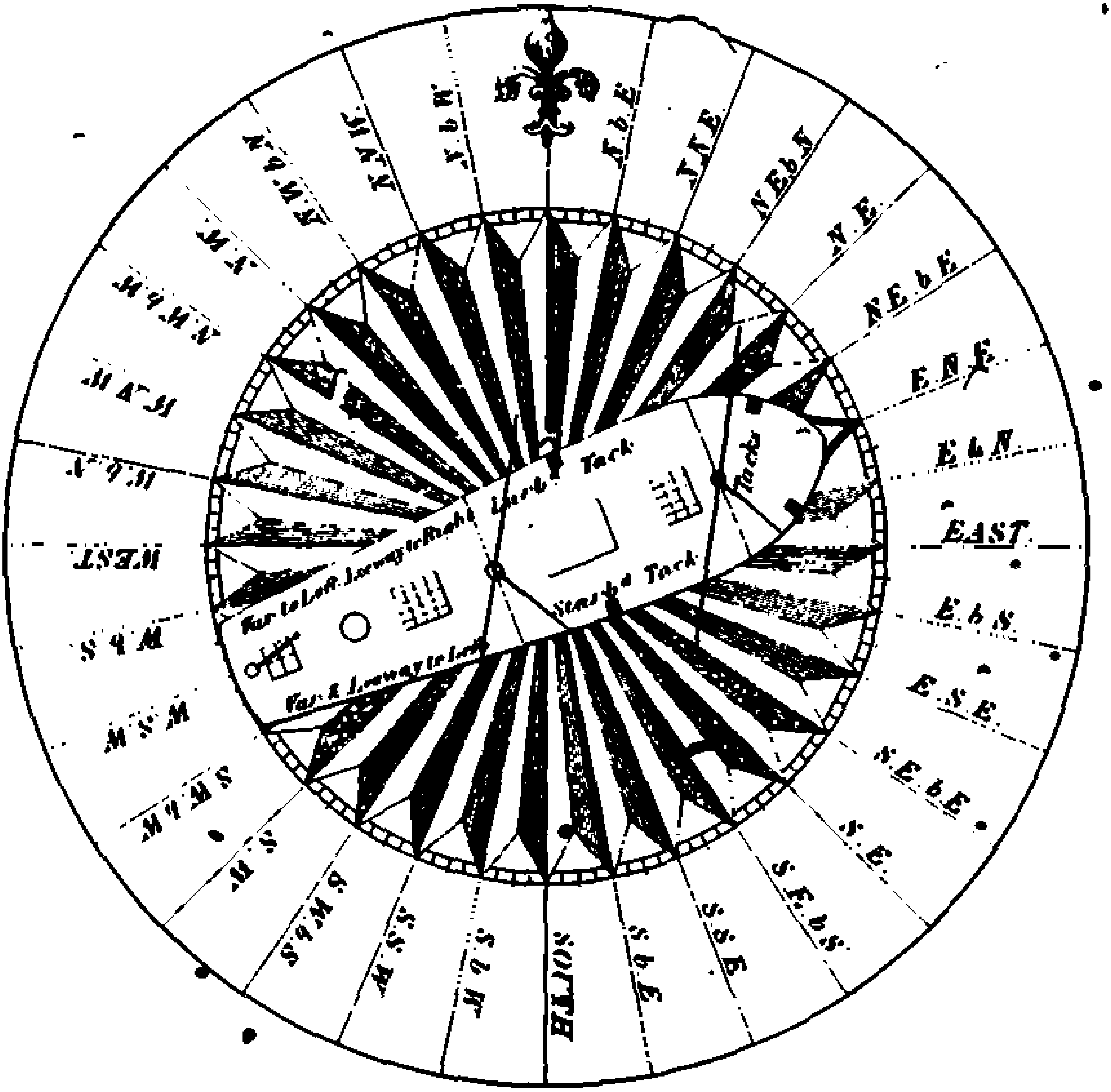

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TO THE HONOURABLE THE

CORPORATION OF THE TRINITY HOUSE, LONDON,

(WHO MOST LIBERALLY ENCOURAGE WHATEVER
TENDS TO PROMOTE USEFUL KNOWLEDGE;)

THIS BOOK,

(CONTAINING MANY USEFUL IMPROVEMENTS IN NAVIGATION,
AND WHICH THEY HAVE BEEN PLEASED TO EXAMINE,)
IS, WITH THE GREATEST RESPECT,

Dedicated,

BY THEIR MOST OBEDIENT,

HUMBLE SERVANT,

EDWARD LOGGAN.

PREFACE.

THE following work is chiefly designed to assist the mariner in determining his latitude, should cloudy weather prevail, preventing him obtaining a meridian, or double altitude, or left to his own resources through various impediments.

Having had long experience as a practical navigator, the author has frequently found much difficulty making a port, or running a parallel, in consequence of not knowing his correct latitude; this difficulty is now, as far as possible, happily removed in the design of this work.

How far the author may have succeeded, he leaves to the candid judgment of mariners, trusting they will not deny him the praise of originality, as no improvements of the kind has ever before been submitted to their inspection.

I have given three methods of finding the latitude, the first by amplitude at sun setting. The second at sun rising; with the ascensional difference superior to the first, as a few miles in the latitude by account, causes no sensible error in the latitude so found.

The third method, by a single altitude of the sun, taken near noon, will give the latitude almost to the nearest mile, and is far superior to a double altitude taken under most favourable opportunities.

Two methods follow finding the variation of the compass, without azimuth, or amplitude, neither requiring the time at ship, or the latitude; an error in both, or either, causes a sensible one in the variation.

Three cases are given, correcting the reckoning by an observation. If carefully attended to, they will approximate very near the truth.

They will be of great service should lunar distances fail, the chronometer prove faulty, or stop.

A projected scheme, accompanied with the same, proves their correctness.

Methods discovering the error of the watch by equal altitudes of the sun, giving the same as if the ship was stationary, during *the interval from the* above;—the longitude at noon may be determined by the chronometer.

Five projections are introduced, proving how a ship through leeway gains, or loses, ground, when close-hauled, sailing on a wind, or laying-to.

The use of the COURSE CORRECTOR, as represented facing the title page, I have also introduced: it will be found expeditious and safe, correcting the courses for variation and leeway, &c.

The whole concludes with the Definitions, which the mariner must well understand prior to his examination; it occupies much of his time when on shore, undergoing tuition. They are only introduced in this work, exampled in so plain and easy a manner, that they may be learnt at leisure any time prior to taking instruction.

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REMARKS.

The improvements made in navigation within this last fifty years for the preservation of a ship are few, that were not known before. The Chronometer is much improved, also the Sextant and Nautical Tables (*for real use*). The Chronometer is liable to change its rates, and frequently stops; yet in most instances has become a very valuable and useful acquisition, determining the ship's longitude, either in short or long periods; truly, considering its delicate construction, and the accidents to which it is liable, no implicit confidence can altogether be placed on it;—nevertherless no ship ought to be without one,—I would recommend three. The lunar observations answer well for long voyages, and in ships that have assistants, they are of the greatest service in detecting a faulty Chronometer, or the gross error of the Longitude by account. It frequently happens during a West India passage, lunar distances cannot be obtained, through various causes; indeed, the only certain resources the mariner has to depend upon is the Latitude, Compass, Log, and Lead-line. As the Latitude can now be obtained almost at any time, should the sun not be obscure, by carefully attending to the rules herein given, correcting the reckoning by the observation, a passage to the West Indies may be made within half a degree of Longitude, which is as near as a lunar observation can be obtained, when an error of one mile in the angular distance causes an error of twenty-eight miles in the Longitude, without referring to other errors liable to creep in, the correct time at ship, altitudes, bad horizon at night, &c.

From what has been said, it will be seen that this small book contains more improvements and useful knowledge to the mariner, than has been made within this last fifty years.

FINDING THE LATITUDE AT SUN SETTING.

This method may be of great service, (having had the sun obscure for several days,) should a clear evening prevail.

EXAMPLE.

Suppose at sun setting I found his true amplitude to be 28° 15′, the declination at the same time was 20° 30′ N., I demand the latitude when the amplitude was observed:

As the sine of the sun's amplitude	28° 15′	9·67515
Is to radius	90°	10·00000
So is the sine of sun's declination	20° 30′	9·54432
		19·54432
		9·67515
To the sine compt. of the latitude	47° 43′	9·86917

90° 00′
47° 43′

Latitude 42° 17′ North

N.B.—Should the latitude by dead reckoning be wrong several miles, it would cause no sensible error, finding the latitude by the ascensional difference.

TO FIND THE ASCENSIONAL DIFFERENCE.

As tangent of radius	45°	10·00000
Is to tangent of latitude	42° 17′	9·95875
So is tangent of declination	20° 30′	9·57273
		19·53148
		10·00000
To the sine of the sun's ascensional difference	19° 53′	9·53148

The ascensional difference 19° 53′, in time, is 1h. 19m. 32 sec.

The ascensional difference, added to six hours, gives the time of sun setting, should the latitude and declination be both of the same name, and the sum it makes subtracted from 12 hours, gives the time of sun rising.

And contrary, if one be North and the other South, the ascensional difference added to six hours, gives the time of sun rising: and subtracted therefrom, the time of sun setting.

	H.	M.	S.
Ascensional difference 19° 53′ in time . . .	1	19	32
Add six hours	6	0	0
Time of sun setting	7	19	32
	12	0	0
Time of sun rising	4	40	28

An altitude of the sun taken after sun rising, would, between the two methods, prove the correct time, and with greater certainty regulate the pocket watch.

N.B. The latitude, found next page by the ascensional difference, would be at sun rising, 4h. 40m. 28s. as above.

TO FIND THE LATITUDE AT SUN RISING,

WITH THE ASCENSIONAL DIFFERENCE, AND SUN'S DECLINATION.

EXAMPLE.

At sun rising, 4 h. 40 min. 28 secs., the ascensional difference was 19° 53′, the sun's declination at the same time 20° 30′ N. Required the latitude.

As tangent of sun's declination .	20° 30′	9·57273
Is to sine of radius	90°	10·00000
So is sine of sun's ascensional difference	19° 53′	9·53161
		19·53161
		9·57273
To the co-tangent of the latitude .	47° 43′	9·95888

90° 00′
47° 43′

Latitude . . 42° 17′ North, by the ascensional difference.

Latitude at sun setting per amplitude 42° 17′ North, the same as before (*see page No.* 1).

I have shown two methods of finding the latitude; the third, annexed, will give the latitude to a greater certainty, and will be found superior to a double altitude, having by chance obtained an altitude of the sun, taken near noon, during foggy weather, without an observation for several days.

NEW METHODS FOR FINDING THE LATITUDE

(*Continued*).

Suppose *for* several days I experienced *foggy* weather, and expecting by my dead reckoning to have the English Channel nearly open, and afraid of running or continuing an E.S.E. course; by chance near noon, I obtained an altitude of the sun, having the time at ship taken from the chronometer, since the last sights, after allowing for the longitude made during the interval since the correct time at ship was known, which was four days. It must be a very bad reckoning for that time to be a degree wrong in longitude. Should this be the case, it would then only cause an error of four minutes in time. Considering near noon, four minutes would cause no sensible error in the latitude, not only near our English Channel, or its parallel, or any other place *situated to the* North or South *of* 45°, particularly should it be in the winter season.

TO FIND THE LATITUDE.

Rule,—Correct the sun's altitude for semidiameter, dip, &c., then take the secant of the latitude, the secant of the sun's declination; their sum, rejecting twenty from the index, will be the log ratio. With the time before noon, find the logarithm rising; subtract this log rising from the log ratio, the remainder will be the common logarithm of a natural number.

Again, find the natural sine of the sun's true altitude; which, added to the natural number already found, will be the natural cosine of the sun's meridian zenith distance. To the sun's meridian zenith distance, add the sun's declination if they are of the same name: if contrary, take their difference; the result will give the true latitude. This method may be depended upon almost to the nearest mile.

EXAMPLE 1.

August 4th, 1838, in latitude by account 48° 53′ N., having had foggy weather for four days, and expecting to have the English Channel nearly open; by chance I obtained a single sight of the sun, whose true altitude was 57° 47′; the chronometer at the same instant showed 11h. 45m. A. M. for ships' time, allowing for the longitude made since the last sights were taken. The latitude is required from the above observation.

Ship's latitude by account	48° 53′	secant	0·18204
Sun's declination	17° 20′	secant	0·02018
Log ratio			0 20222

Logarithm rising to 15 minutes from noon	2·33063
Subtract log ratio	0·20222
The logarithm of a natural number, 134	2·12841

Natural sine of the sun's true altitude	57° 47′	84604
Add the logarithm of the natural number		134
Natural cosine of the sun's meridian zenith distance	32° 04′	84738

Zenith distance	32° 04′ N.
Sun's declination	17° 20′ N.
Latitude	49° 24′ North.

EXAMPLE 2.

At sea, November 24th, 1828, in latitude by account 48° 12′ N. and longitude 8° 30′ W., running for the English Channel, without an observation for three days, I observed the sun's true altitude to be 19° 55′; at the same instant the chronometer showed 11h. 10m. 15s. for ship time: the ship steered true till noon E.N.E. 7 miles, when a meridian altitude was obtained, which gave the latitude 48° 37′ N. The latitude is also required at noon from the above observation, taken at 11h. 10m. 15s., the time at ship.

Ship's latitude by account . .	48° 12′ secant	0·17618
Sun's declination . .	20° 38′ secant	0·02879
Log ratio		0 20497

Logarithm rising to 49′ 45″ from noon	3·37048
Subtract log ratio .	0·20497
Logarithm of a natural number, 1464	3·16551

Natural sine of the sun's true altitude 19° 55′	34065
Add the logarithm of the natural number .	1464
Natural cosine of the sun's meridian zenith distance 69° 11′ . . .	35529

Zenith distance . .	69° 11′ N.
Sun's declination . .	20° 38′ S.
Latitude in at 11h. 10m. 15s. .	48° 33′ North.
Latitude made by course, and distance to noon	+ 3′
Latitude in at noon from the above	48° 36′ North.

N.B. The latitude found at 11h. 10m. 15s., allowing for the latitude made to noon, differs only one mile from the meridian altitude.

SHEWING THE TIME AT SHIP FROM THE CHRONOMETER.

At sea, 22nd September, 1850, the apparent time at ship was 11h. 6m. 8s., at the same instant the chronometer shewed 1h. 30m. 0s., Greenwich apparent time, allowing its rate and equation. The ship sailing to the eastward until the 26th, having made during the interval 500 miles of longitude, or 8° 20′ E.; the apparent time at ship is required from the chronometer, it shewing Greenwich apparent noon.

	H.	M.	S.
Sept. 22nd, apparent time at Greenwich	25	30	0
Ditto apparent time at ship . .	23	6	8
Ship slow of Greenwich	2	23	52
Longitude made during the interval, 8° 20′ in time		33	20
Ship slow of Greenwich apparent time . .	1	50	32
26th Sept., apparent noon at Greenwich	24	0	0
Ship slow of ditto	1	50	32
Time at ship	22	9	28

	H.	M.	S.	
	22	9	28	
	12	0	0	A.M. civil time at ship, 26th Sept., when the
Remains	10	9	28	

FINDING THE LATITUDE WITHIN THE ARTIC AND ANTARTIC CIRCLE.

At either of the poles, between the Artic and Antartic sweep, which is 23° 28′ the extreme of the sun's declination at certain seasons of the year, one pole is lighted, the other in darkness. Suppose in summer North latitude, the North Pole would receive light from the sun day and night; in this case the sun would not set, although in sight; it would be on the meridian below the pole.

A ship off the Greenland coast found her meridional zenith distance 79° 58′ North, the sun's declination was 21° 10′ North; the ship's true latitude is required.

To the meridian zenith distance	79° 58′ N.
Add the sun's declination	21 10 N.
	101 08
Subtract the extreme of the Poles . .	180 00
Latitude	78 52 North

The sun's true altitude would be 10° 2′.

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ON THE COMPASS.

WHEN from the bosom of the mine
The magnet first to light was shewn,
Fair Commerce hail'd the gift Divine,
And smiling, claim'd it for her own.
" This gem," she said, " my bark shall guide
Through tracks of oceans yet untried;
While as my daring sons explore
Each rude, inhospitable shore,
'Midst deserts, sands, and ruthless skies,
New seats of industry shall rise,
  And culture wide its genial reign;
Free as the ambient gale,
  And boundless as the main."

TWO NEW METHODS OF FINDING THE VARIATION OF THE COMPASS.

Take an altitude of the sun when about three hours distant before noon; at the same instant, with an azimuth compass, take its bearing; in case your quadrant index might move during the interval, note down the altitude and the sun's bearing; now about 9 A. M., or the time the first altitude was observed, taken from noon or 12 hours, would be about 3 P. M., a short time before; again observe when you have the same altitude, and again find its bearing: should both bearings be equal, there will be no variation at the place of observation; your compass will point true.

EXAMPLE.

At about 9 A. M., I observed the sun's apparent altitude to be 41° 54′, at the same instant bearing E.S.E. ¼ E., or 69° 36′; and at about 3 P. M. the sun had the same altitude, bearing south 42° 35′ west, or S.W. ½ south nearly. The variation is required.

Sun's bearing before noon	S. 69° 36′ East.
Do. do. in the afternoon	S. 42° 35′ West.
Difference	2) 27° 1′

The half difference is the variation 13° 30′ 30″ West.

N.B.—Proving the variation is westerly, as the point in the forenoon is further to the east than the afternoon

VARIATION OF THE COMPASS BY THE NORTH POLE STAR.

When the guards or pointers of the Great Bear are right under the Polar Star, it is then on the meridian above the Pole. When the guards or pointers are right over the Polar Star, it is then on the meridian under the Pole. At either of the above-named positions is the proper time for observation, as the star will then point due north.

TO FIND BY THE ABOVE THE VARIATION.

Take your azimuth compass and turn it towards the Polar star; when you observe the thread on the slit cut on the star, the index will show the true north. As many degrees as the north point is on the east side of the index, the variation is westerly; or as many degrees as the index is from the north point, on the west side the variation is easterly.

N.B.—This rule is so plain, that it requires no example. These two methods of finding the variation of the magnetic compass are so easy and correct, that they will

REMARKS.

The following page shows an azimuth taken by me at sea, and calculated in the usual manner. Also showing on the same day the variation by equal altitudes; and at night, a few hours afterwards, the variation by the Polar Star; where will be seen my methods as in p. 26, &c., agree, and give the same variation. The variation by the azimuth differs full two degrees, which is generally the case; seldom having at sea the correct time, or the latitude, when the azimuth is taken. My two new methods require neither.

The following azimuth was taken by me at sea:—

July 15th, 1824, in latitude by account 32° 14′ N., and longitude 14° 26′ W., at 6h. 52m. 25s. A.M.; the sun's magnetic azimuth was 84° 35′ E., his true altitude at the same time was 22° 15′, required the true azimuth.

Ship's latitude	32° 14′			Secant 0·07269
Sun's true altitude	22° 15′			Secant 0·03360
Sum	54° 29′	Nat. cosine	58094	
Sun's declination	21° 30′	Nat. sine	36650	
		Log	94744	497679
		Log rising 6h. 48m. 40s.		5·08308

6h. 48m. 40s. in degrees is 102° 10′, or the true azimuth.

Magnetic azimuth 84° 35′

Variation 17° 35′ West.

Variation equal altitudes . 19° 38′ 06″ W.

Variation by the Polar star 19° 41′ 00″.

N.B.—The methods by equal altitudes, and Polar star, prove to be the best.

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AN IMPROVED METHOD

FOR

CORRECTING THE DEAD RECKONING BY AN OBSERVATION.

CASE I.

When you are certain your ship has made not exceeding a two point course, in this case the error must be in the distance, or very little in the course, with the course and meridinal difference of latitude by dead reckoning; and also between the two observations, find the longitude made by both; should they disagree, take their difference, which will be the true difference of longitude made.

N.B.—Should the course be within two points, the error must then be in the distance altogether; then, with the course by difference of latitude and departure, and meridinal difference of latitude between the observations, find the difference of longitude.

CASE II.

This case requires the most consideration. Should you be certain, after making all proper allowances, and find your ship has made about a four points course, or 45°, and should this truly be the case, the error would fall on the course and distance; that is, if both had an equal part. Experience has taught me in most cases, the error more frequently falls on the distance, than on the course, without the ship in general steers wild; it is also more prudent to be on the safe side, having one side of the triangle certain, than to allow an equal difference on the course and distance.

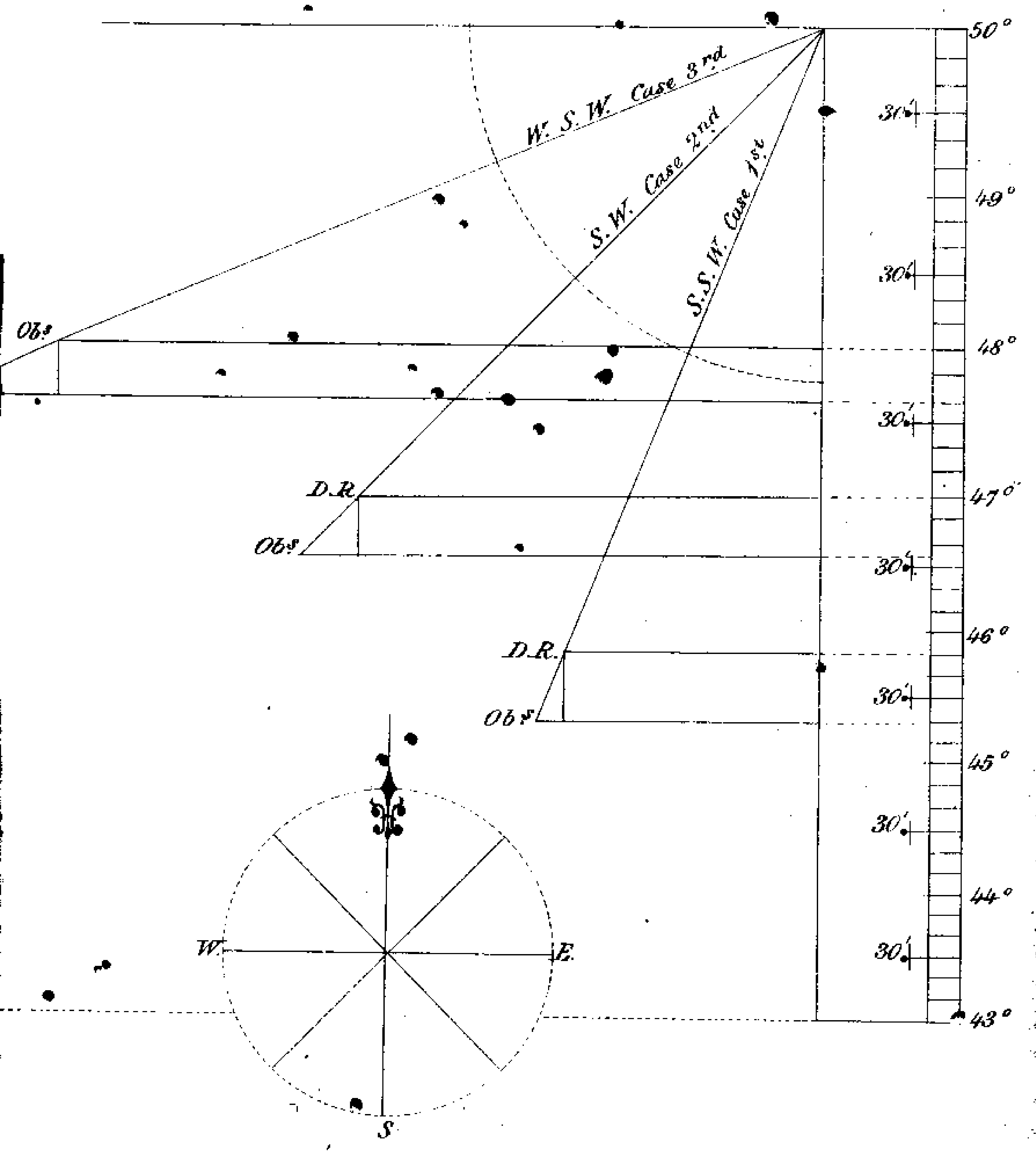
With the course, and difference of latitude by observation, find the difference of longitude; again find a new departure, take the difference between the two, and find the true course; with this true last-found course, and meridional difference of latitude between the two observations, again find the difference of longitude, and should those not agree, take their difference, which will give the correct difference of longitude.

CASE III.

Should you be certain your ship has made a full six points course, and good allowance made for the variation, steering, also leeway, if any; considering in this case, as the ship has made so large a course, it appears plain the error will fall most on the course. Now, with the distance and difference of latitude by observation, find the true course and departure; with this find the difference of longitude. When the course is large, it is best to depend on middle latitude sailing, only observe to make use of the new departure as above, taking with it the complement of the middle latitude, as a course in the distance column, will stand the corrected difference of longitude.

N.B.—You may make a second correction for finding the difference of longitude made, with the complement of the middle latitude and the distance; find the difference of longitude: should they not be the same, take their difference, which will be the correct difference of longitude to a mile.

This projection shows at sight
where the error lies between the
Dead Reckoning, & Observation.



DISCOVERING THE ERROR OF THE WATCH

BY

EQUAL ALTITUDES OF THE SUN, TAKEN AT SEA.

Equal altitudes of the sun have been adapted for shore purposes, discovering the error of the watch, generally taken by an artificial horizon at long intervals. It ought to be well understood, the refraction for morning and evening altitudes are not the same; although the tabular allowances make no difference, equal altitudes may with confidence be used at sea, taken at short intervals, which at no time ought to exceed two hours and a half, will, with greater certainty, avoid the difference of refraction, and the unnecessary trouble calculating the equations; indeed, for sea purposes the latter is of little or no consequence. It may seldom happen a ship will be stationary at sea; the calculation may be made by observing the angle between the sun's bearing and the ship's course; the latitude made in consequence, applied to the A.M. altitude, will be the P.M. altitude the sextant ought to shew, and will be found thus:—should the angle be less than eight points, the latitude made is to be added to the A.M. altitude for the P.M. altitude, or subtracted from it, should it be more,

TO FIND THE ERROR OF THE WATCH BY EQUAL ALTITUDES.

EXAMPLE 1.

At sea, 14th October, 1848, at 10h. 53m. 46s., A.M., the sun's apparent altitude was observed to be 26° 10′, bearing at the same time by azimuth compass S. by E. ¼ E., the ship sailing on an E.S.E. course during the interval, which distance was 14 miles; required the afternoon altitude, and the error of the watch at 1h. 17m. 12s. P.M.

Ship's course E.S.E., or	6	points A.M., alt.	26°	10′
			+	11
Sun's bearing S. by E. ¼ E.,	1¼	ditto, P.M., alt.	26	21
Difference between ship's course and bearing ...	4¾	angle with 14 miles distant gives 11′ for lat.		

	H.	M.	S.			
Time per watch, A.M.,	22	53	46	altitude	26°	10′
Time per watch, P.M.,	25	17	12	do.	26	21
Sum	48	10	58			
Middle time or half sum	24	5	29			
	24	0	0			
Watch fast for the merid.	0	5	29			

N.B.—The angle 4¾ points with the distance 14 mile and gives 11 miles, which, added to 26° 10′, gives 26° 21 the P.M. altitude the sextant ought to shew.

EXAMPLE 2.

At sea 16th March, 1849, at 23h. 10m. 18s. A.M., the sun's apparent altitude was found to be 33° 25′, at the same time bearing, per azimuth compass, South ¾ E; the ship sailing N.E. at the rate of four miles per hour during the interval, making one point leeway on the larboard tack; the P. M. altitude is required, and the error of the watch.

The angle of the sun, and ship's course, with one point leeway, is 10¼ points, which, taken from sixteen points, leaves 5¾ points; with the said 5¾, and the distance run seven miles, gives the latitude, 3 miles, to be subtracted from the A.M. altitude, for the P.M. altitude.

	H.	M.	S.		
Time per watch A.M.	23	10	18	Altitudes	33° 25′
Time per watch P.M	24	36	30	Do. for P.M.	33° 22′
Sum	47	46	48	The altitude the sextant ought to shew.	
Middle time	23	53	24		
	24	0	0		
Watch slow for apparent noon	0	6	36		

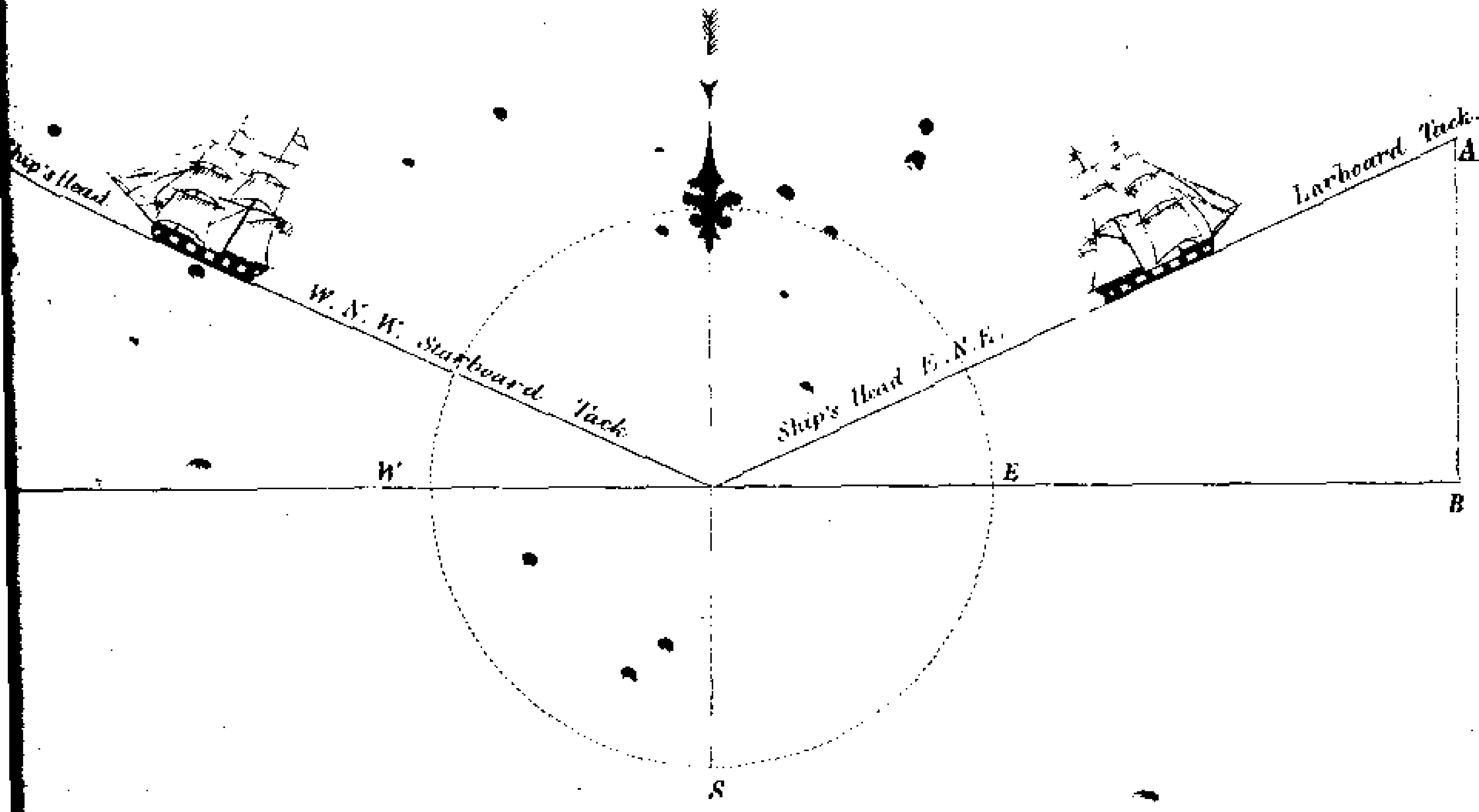
The above method for finding the error of the watch by equal altitudes is superior to the usual methods, the latitude and sun's declination not being required; a few miles error in both, or either, causes a very sensible one in the time found, and increases the more so towards noon.

N.B.—The wind in the Projections, pointed out by an arrow, is supposed to be at North. The ship's head, E.N.E. laying six points from the wind.

Turning to Windward explained

When a Ship makes her Course good within Eight points of the wind, she gains ground; or goes to Leeward from her place, should her course exceed Eight Points from the Wind. Square Rigged Vessels, with smooth water, and all Sail set, will make their Course good Six points from the Wind. Fore and Aft Vessels will lay nearer.

Projection 1st

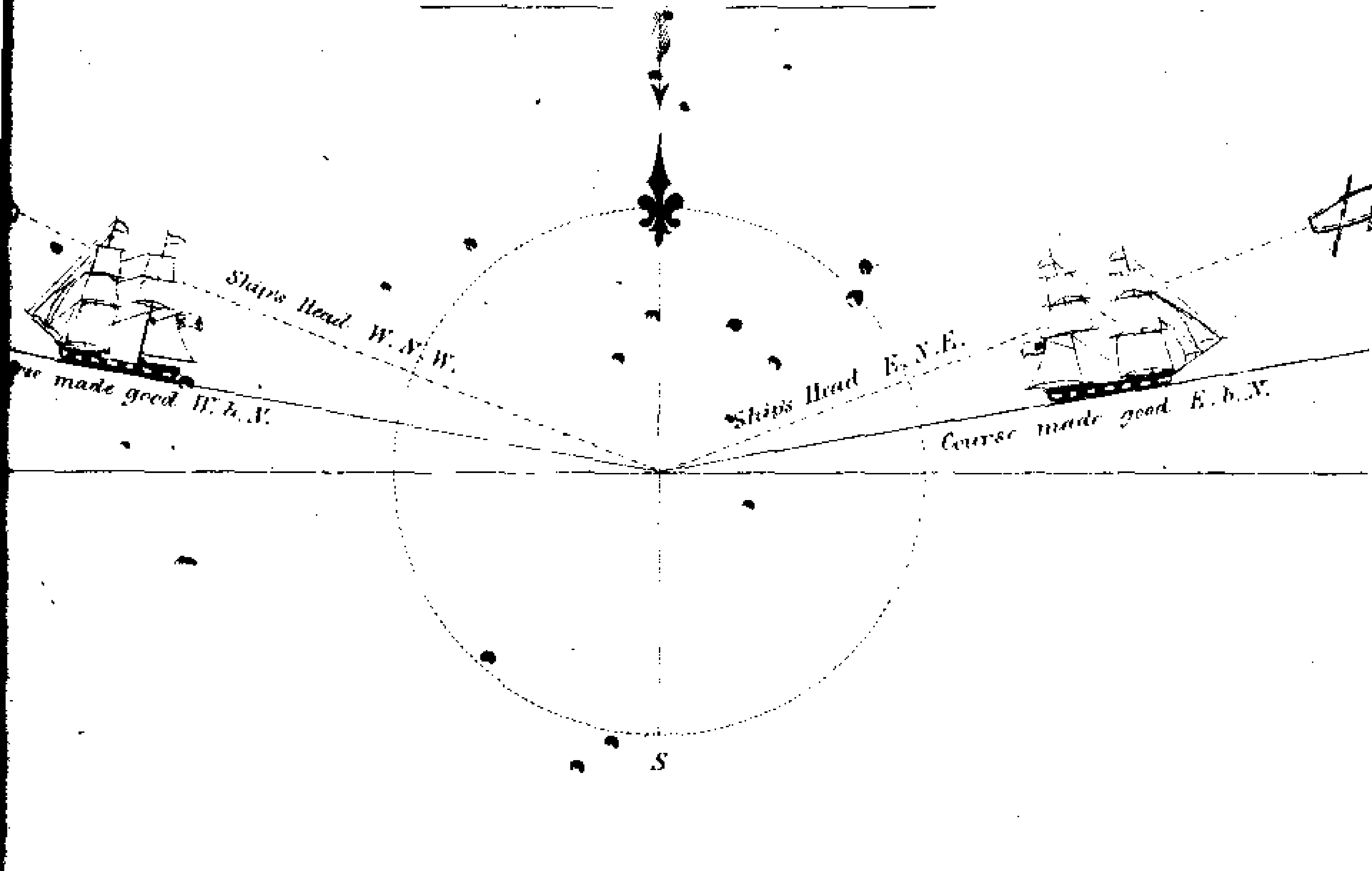


proving the Ship gains Two points to Windward, on each Tack; also the distance between A B and C D is the ground gained on each Tack.

Turning to Windward

Projection 2nd

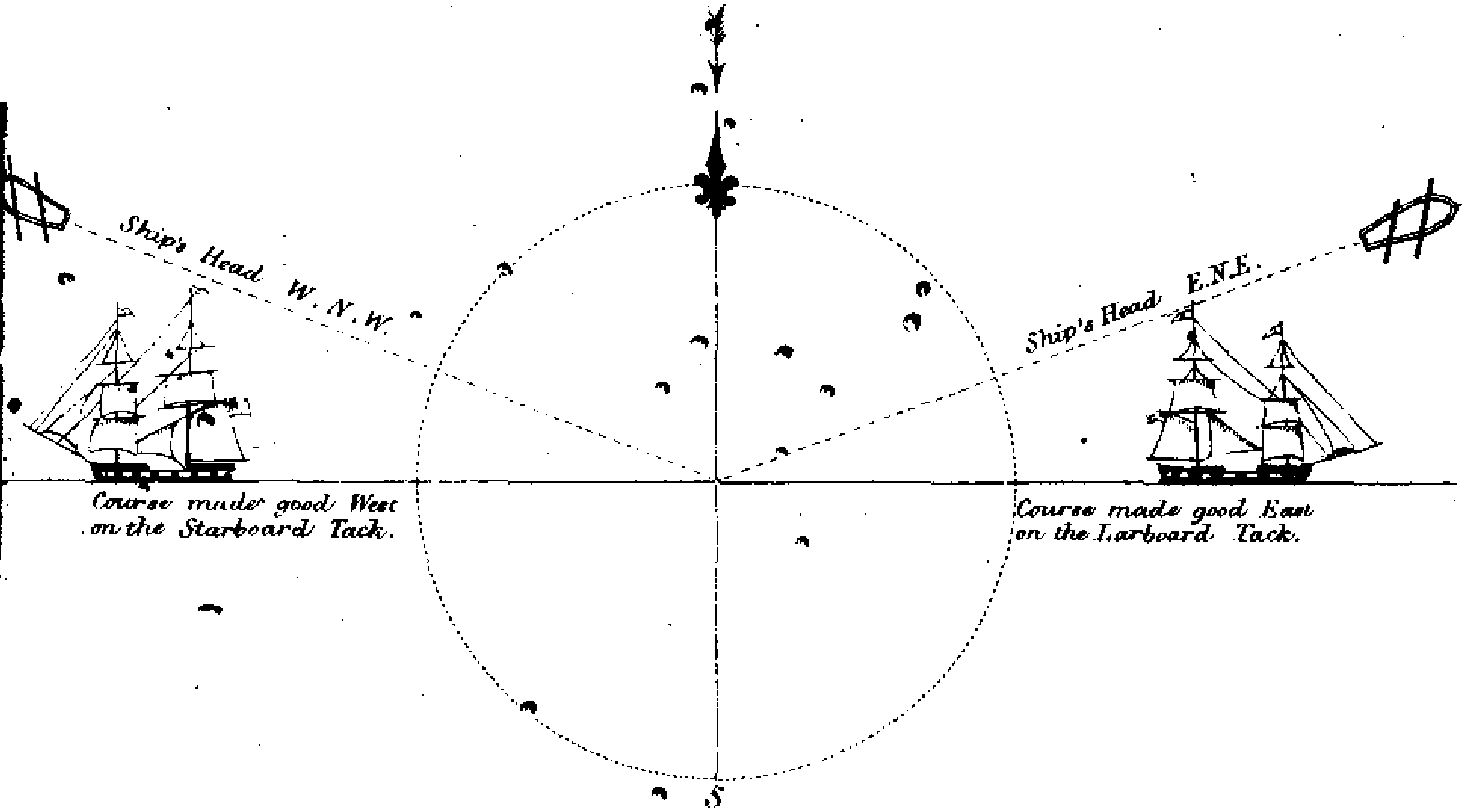
Should a Ship make One point Leeway, she makes her Course good Seven points from the Wind, and gains to Windward One point on each Tack from where she may have sailed from.



The above Projection proves the Ship gains to Windward One point, making her way good Seven points from the Wind. The distance between **A** & **B** is the ground she has gained on the Larboard Tack, **C** and **D** on the Starboard Tack.

Projection 3rd

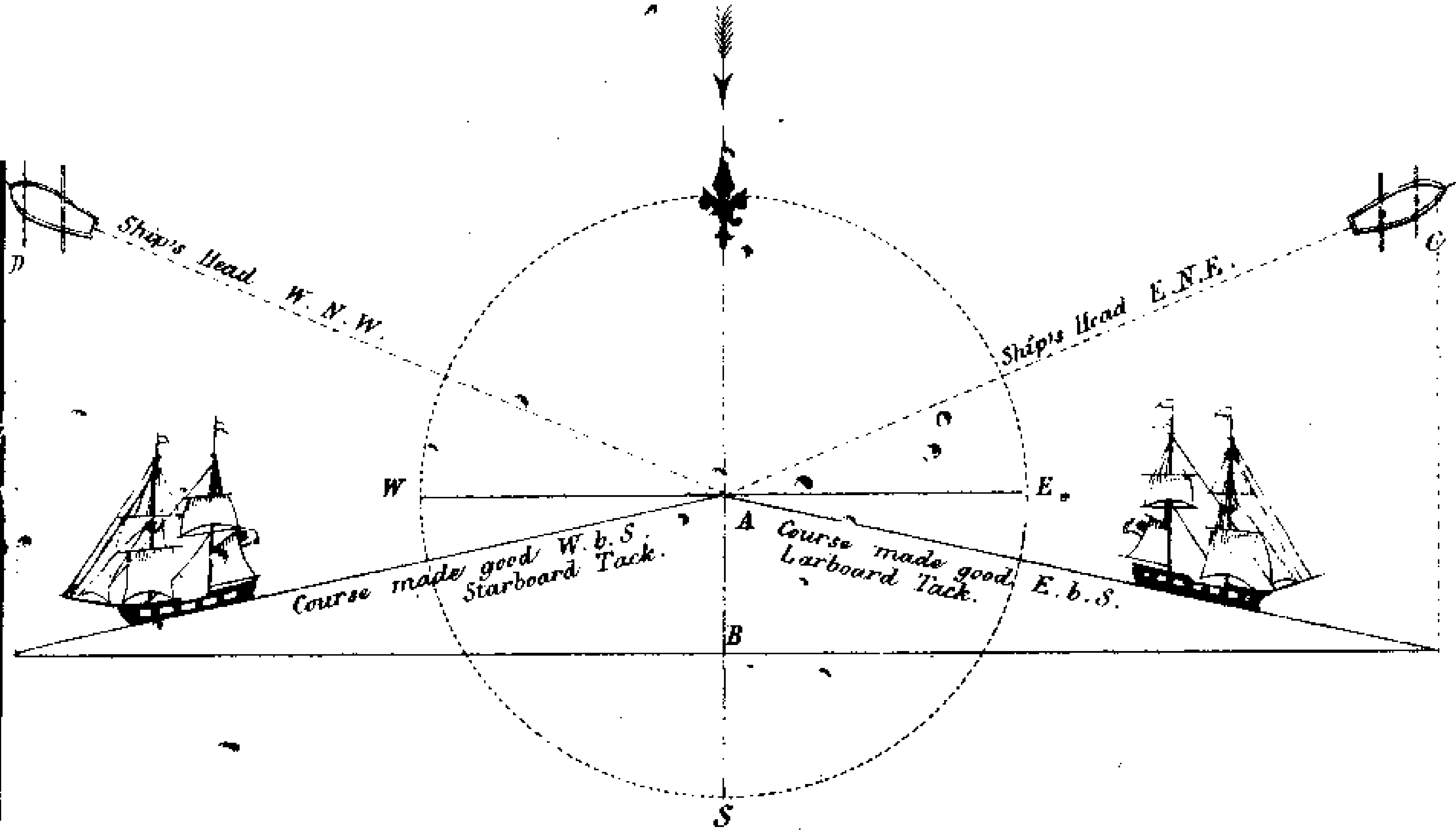
This Projection clearly shows a Ship when making Two points Leeway: her true Course is Eight points from the Wind, which proves she neither gains nor loses ground, holding only her own, on either Tack.


Ship's Head W.N.W.
Ship's Head E.N.E.
Course made good West on the Starboard Tack.
Course made good East on the Larboard Tack.
S

The above Projection proves when a Ship makes Two points Leeway, she cannot gain advantage by Tacking, and would only arrive at the place she Tacked or Sailed from.

Projection 4th

This Projection shows a Ship making Three points Leeway, which makes her Course good Nine points from the Wind: In this case she will lose ground One point in the distance she may sail on either Tack.



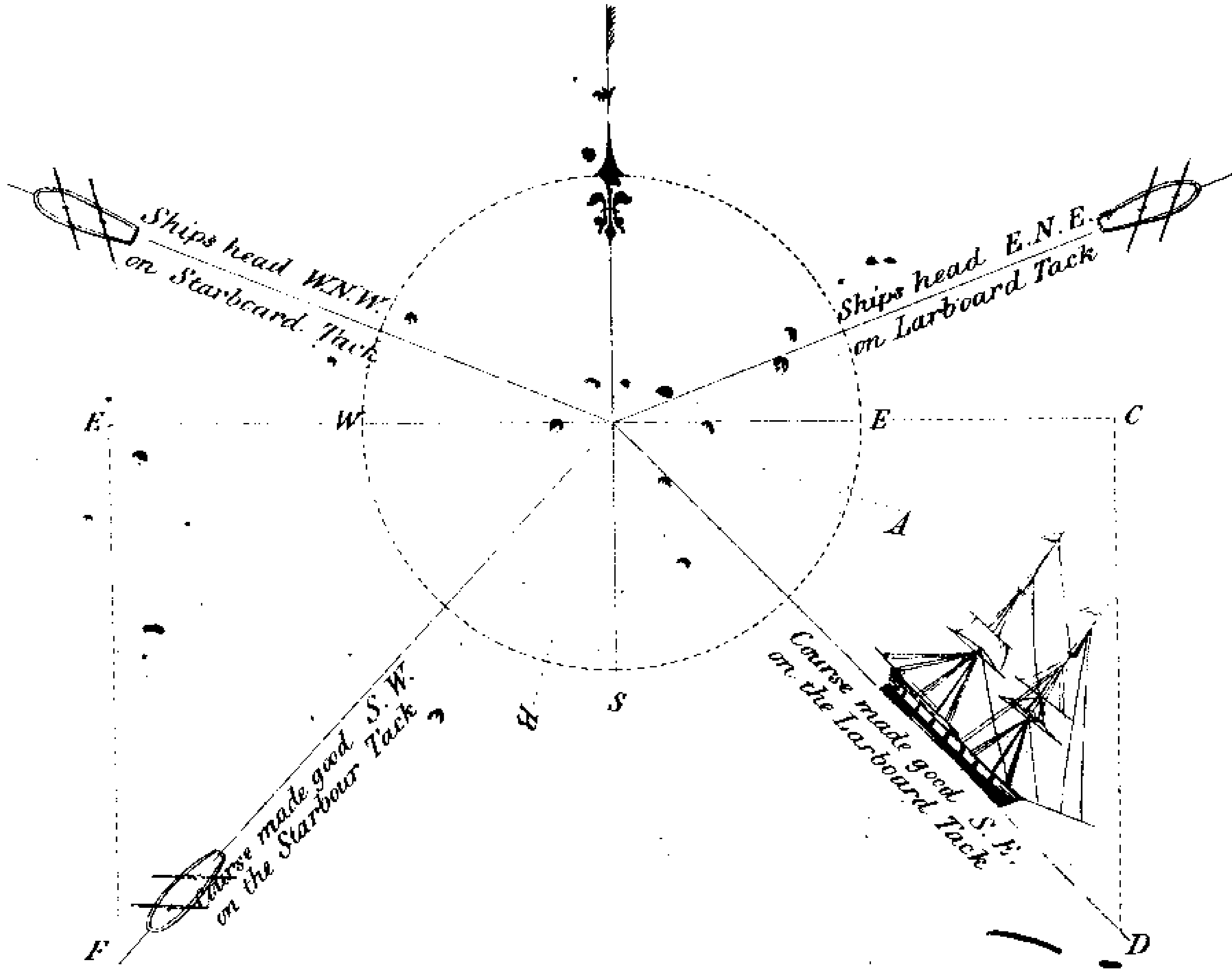
The above Projection shows the Ship's head E.N.E. making Three points Leeway, which makes her Course good E. b. S. on the Larboard Tack, and W. b. S. on the Starboard Tack. The space between **A** and **B** is the ground she has lost on each Tack, or without Leeway she would have been at **D** on the Starboard, and **C** on the Larboard Tack.

a
I
E
y
.
c
s
i

The annexed Projection (page 49) shews the ship close-hauled, laying-to, with her place for leeway only on each tack. For instance, had there been two points and a half Westerly variation, and allowed for, the ship would be at A, or E. by S. $\frac{1}{2}$ S. on the larboard tack, and at B, on the starboard tack. It is to be understood, the variation of the compass neither assists or retards a ship gaining ground by tacking.

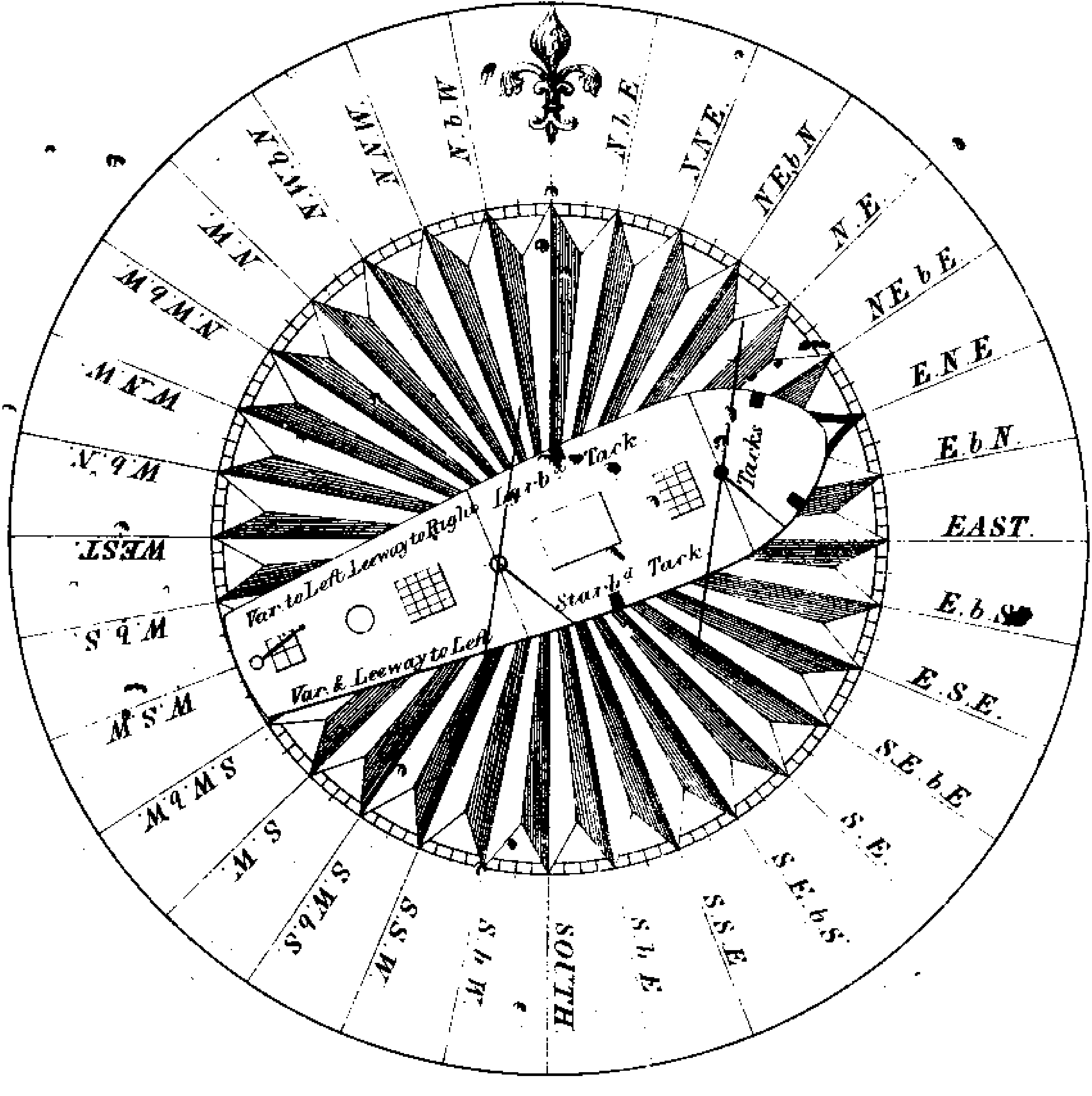
Projection 5th

Lastly, we see the Ship Laying too, in a hard gale of Wind, under a Close-reefed Main Topsail; with her head as before, making Six points Leeway which will make her Course, or drift, Twelve points from the Wind; proving she loses ground Four points on her drift, on either Tack she may be placed on.



By the above projection, showing the Ship making Six points Leeway, it proves the space between C. and D. is the ground the Ship has lost when on the Larboard Tack, and E.F. on the Starboard Tack.

THE COURSE CORRECTER



USE OF THE COURSE CORRECTOR.

Having had considerable practice in teaching Navigation, practical, and theoretical, I have frequently found ship-masters and mates in error in correcting the courses for variation and lee way, when working a day's work, more so in the traverse table, when it is required; such errors have in many cases proved fatal to ships, lives, and property. To remedy this defect as far as possible, I have introduced in this book the use of my Course Corrector; it will be found to be very expeditious and safe, not only in correcting courses, but also in taking the angles in double, and equal altitudes, should the ship make much way during the interval, throwing aside its great utility —teaching practical seamanship, which in this book is omitted, the same requiring personal explanation and tuition, which only can be done by a practical seaman teacher.

When a ship is on the starboard tack, with westerly variation, making leeway, both are to be allowed to the left hand when looking at the course steered; the ship is then to be moved to the left as many points as they come to, which will point out or shew the corrected course.

Should a ship be on the larboard tack, the leeway she makes will be to the right hand.

If the variation be to the left, then take the lesser from the greater; and should the leeway exceed the variation, move the ship to the right, and that difference from the point steered will shew the corrected course.

Should the leeway be less than the variation on the larboard tack, as above, the ship is to be moved that difference from the point steered to the left, which will point out the corrected course.

N.B.—The above remarks are with westerly variation. Should the variation be easterly on the starboard tack, the leeway and variation check each other,—that is the variation is to be allowed to the right hand, the leeway to the left.

If on the larboard tack, the leeway and variation are both one way, and the sum they make is to be allowed to the right hand from the point steered.

EXAMPLES.

	POINT.
On starboard tack, ship's head W.N.W., leeway	1¾
Variation	2½ W.
Sum	4¼ pts.

The ship, moved 4¼ points to the left hand from the course W.N.W., will point out W.S.W. ¼ S., or S. 5¾ points W., the corrected course.

	POINTS.
On larboard tack, ship's head N.E. leeway	1¼
Variation . . .	1¾ W.
Difference . . .	½ pt.

As the variation exceeds the leeway half a point, and on the larboard tack, the ship's head moved half a point to the left from the course N.E. steered, will shew the corrected course N.E. ½ N., or North 3½ points East.

On larboard tack, ship's head S.S.W., leeway 2½
Variation . . . 1¼ W.
Difference . . . 1¼ pt.

The variation as above being less than the leeway 1¼ points, the ship also on the larboard tack, move the ship 1¼ points to the right hand of the course steered S.S.W., which will shew the corrected course to be S.W. ¾ S., or South 3¼ points West.

N.B.—By carefully attending to the rules and examples given, with a little practice, the mariner will at any time be able to correct the courses for leeway and variation without the least chance of mistake.

NOTE.

I have given instructions to mariners in general, and frequently found them deficient in the Definitions, which ought to be well understand prior to passing examination, to save time learning them on shore, which may be easily done on shipboard at their spare leisure. I have inserted in this book such Definitions, as will answer every purpose for their own tuition, and pass examination in as plain and easy a manner as possible.

DEFINITIONS.

THE ZENITH, &c.

The Zenith is that point in the heavens directly over our heads; the Nadir is the point opposite the Zenith. Thus, the Zenith and Nadir are the poles of the rational horizon.

POLES OF THE WORLD.

The North and South of the heavens or earth, as North and South Poles of any great circle, are 90° from that circle. Thus, the zenith and nadir are Poles of the horizon.

GREAT CIRCLES.

The meridian is derived from the Latin, *meridies*, or mid-day. This circle passes through the poles of the world, the zenith and nadir, also the North and South points of the horizon; unto this circle any day in the year when the sun cometh, it is noon or mid-day, or when the moon or stars touch this circle, they will be on the meridian, which will be their greatest altitude that night.

A Great Circle upon a sphere, is that whose plane passes through the centre of the sphere.

A Less Circle is that whose plane does not pass through the centre of the sphere. From what has been said, all Great Circles divide equally, and Less Circles divide it unequally.

HORIZON.

Horizon; natural or visible, is as far as you can see in all directions, the sea appearing as if round. A circle passing through the centre of the earth, is called the rational horizon.

AZIMUTH, OR VERTICAL CIRCLES.

Those are great circles passing through the zenith and nadir, and intersect the horizon at right angles.

AZIMUTH.

The Azimuth is an arch of the horizon contained between the Azimuth or vertical circle, passing through the centre of the object and the meridian of the place.

PRIME VERTICAL.

That vertical circle which passes through the East and West points of the horizon, is called the Prime Vertical.

SOLISTIAL COLURES.

The Solistial or Solistitial Colures passeth through the points of Cancer and Capricorn, zenith, nadir, North and South points of the horizon; those two Colures divide the equinoctial ecliptic and all the heavens into four equal parts, and show the four principal points of the ecliptic, to which when the sun comes, he distinguishes each quarter

MERIDIANS, OR HOUR CIRCLES; ALSO CALLED CELESTIAL MERIDIANS.

They meet together in the poles of the world, and cross the equinoctial at right angles. Twenty-four of these divide the equinoctial into equal parts, each containing 15°, and are called hour circles.

N.B.—The prime or first meridian, the axes of the world, is the six o'clock hour line, A.M. or P.M., that is, morning or evening, this is called, or ought to be, the first meridian.

THE MERIDIAN OF A PLACE.

The Meridian of a place on the celestial sphere, is that vertical circle which passes through the poles, crossing the equinoctial at right angles. This circle is the terrestial meridian of a place, extended to the heavens; it divides the heavens into two hemispheres, the Eastern and Western. When the sun is on the meridian of a place above the horizon, it is noon; and under the horizon, it is midnight.

Time is taken thus, the hour of the day is an angle made at the poles between the meridian of the sun and the meridian of the place, as the axes of the world is the six o'clock hour line, which is the first meridian: this ought to be well understood.

THE ZODIAC.

The Zodiac is a space in the heavens extending about eight degrees on each side of the ecliptic, like a belt or

CIRCLES OF LONGITUDE.

Circles of Longitude of the sun or stars cut the ecliptic at right angles, and intersect each other in the poles thereof, which are 23° 28′ from the poles of the world.

THE ASCENSIONAL DIFFERENCE.

The Ascensional Difference is the difference between the right and oblique ascension, or it is an arch of the equinoctial contained between the points of right and oblique ascension, and shows how many hours the sun rises, or sets before, or after, the hour of six; or half the time a star is above, or below the horizon, exceeds or wants of six hours.

THE DECLINATION.

The Declination is an arch of the meridian contained between the sun and the equinoctial, and showeth how far the sun, or a star, is to the Northward or Southward of the equinoctial; the sun's declination at greatest is 23° 28′, and is the angle the ecliptic makes with the equinoctial, that is about 47° from the tropic of Cancer, North of the equator, to the tropic of Capricorn, south of the equator.

This Declination is caused by the world laying 23° 28′ on an angle of 90°. Should the world be upright, there would be no declination; the zenith distance would be the latitude of a place; day and night would in all places be equal, excepting at the poles which would for ever be lighted. The declination also causes the seasons.

THE ECLIPTIC.

The Ecliptic is that great space in the heavens which the sun appears to describe in the course of a year, and is the orbit of the earth extended to the celestial sphere. It is inclined to the equinoctial in an angle of 23° 28', called the obliquity of the ecliptic, and cuts it in two points diametrically opposite, called the equinoctial points; those two points of the ecliptic, 90° distant from the equinoctial *points, are called the solstitial points.*

N.B.—That great space in the heavens which the sun appears to describe in the course of a year is frequently called the sun's path.

POLAR DISTANCE.

The Polar Distance is an arch of the meridian, contained between the centre of the object and the pole of the equinoctial.

THE LATITUDE OF AN OBJECT.

The Latitude of an object in the heavens is an arch of a circle of celestial longitude, intercepted between the object and the ecliptic, and may be called North or South, according as the object is North or South of the ecliptic.

THE TROPICS.

The Tropics are two lesser circles parallel to the equinoctial at 23° 28′ distance from it, touching the ecliptic at the solstitial points, the Northen tropic touches the ecliptic at the beginning of Cancer, and is called the Tropic of Cancer; the Southern tropic touching the ecliptic at the beginning of Capricorn, is called the tropic of Capricorn.

POLAR CIRCLES.

The Polar Circles are two lesser circles, 23° 28' distant from the poles of the equinoctial; that about the North is the Arctic circle; and the other about the South, the Antartic circle.

ALTITUDE.

The Altitude of a celestial object is an arch of a vertical circle, intercepted between the centre of the object and horizon.

THE ZENITH DISTANCE.

The Zenith Distance is an arch of a vertical circle, contained between the object and the zenith; when the object is on the meridian, its altitude or zenith distance, is called the meridian altitude, or meridian zenith distance.

ZONES.

From 23° 28′ North or South of the Equator that space is called the Burning Zones; from the poles, 23° 23′, that space is called the Frozen Zones; and the *two* spaces between the polar circles and the tropics of Cancer and Capricorn are the Temperate Zones.

The Torrid Zone is the space between the two tropics, over every part of which the sun is vertical at some time of the year.

SIDEREAL TIME.

Sidereal Time, at mean noon, [illegible] the angular distance of the first point of Aries, or the true Vernal Equinox, from the meridian at the instant of mean or true noon. The Sidereal clock is the right ascension of the mean sun, or the time it ought to shew at Greenwich, when the true or mean clock shews 0h. 0m. 0s, a sidereal clock represents the rotation of the earth as referred to the stars. Sidereal Time is named by some star time; although not correct, this definition ought to be well understood.

CONCLUSION.

The author at the commencement of this work, only intended to publish his improvements in navigation; as a teacher finding the Definitions occupies much of the mariner's time on shore, when under tuition, prior to passing examination, he has made use of such definitions that are most useful and required: they are explained in so easy a manner as to be learnt on ship-board at leisure without a teacher. Some of the examples contained in this book might have been further augmented, considering the brief and simple manner in which they are elucidated, the mariner will never find himself deficient in understanding the same, provided he is acquainted with the use of the tables, Logarithms, Sines, Tangents, &c., which in this work are not introduced, declining to make use of or interfering with other author's productions whatever. The Projections by some may be thought little improvement; I have to say, in no book of Navigation have they been projected or explained; they will answer well pointing out the tack a ship ought to be put on, to gain advantage in sailing, or laying-to, and also avoiding danger, &c., &c.

"Deus Dabit Vela."

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